Procedures and Guidelines for Working Safely in the MCS Machine Rooms

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I General Guidelines

I.a MCS Machine Rooms

The machine rooms in use by MCS are as follows:

- •Big Machine Room (BMR) - 221/B132
- •Hackspace - 221/C120
- •Little Machine Room (LMR) - 221/D131
- •Visualization Laboratory - 221/D131A

The rules and guidelines discussed in this document apply to all of these spaces.

I.b For Anyone Working in the Machine Rooms

1. Follow approved Integrated Safety Management (ISM) guidelines for planning and carrying out work.
2. Obtain approval from appropriate MCS Staff or Building Manager as necessary before beginning work.
3. Complete required training related to the task to be completed.
4. Use appropriate number of individuals to compete the task safely.
5. Use tools and other assistive devices (ladders and equipment lifts) in the manner for which they were designed and according to the manufacturers' guidelines.
6. Inspect tools before use. Defective tools should be removed from service and tagged "do not use."
7. Use a Ground Fault Circuit Interrupter (GFCI) with all hand-held, corded power tools.
8. Use appropriate Personal Protective Equipment (PPE) when using tools.
9. Do not place items on top of equipment or racks.
10. Do no block access to any aisles, doors, racks, Halon pull-stations, or electrical panels.
11. Maintain a 36-inch clearance in front of all electrical panels and disconnects.
12. Use barricades, cones, caution tape, signs and other warning devices to identify temporary hazards and active work areas (See section VI.c for details).
13. Avoid storing combustible materials (i.e., boxes, skids, shipping materials, etc.) for extended periods of time.
14. Review the evacuation route maps.

I.c Work Areas

When required as part of the ISM Planning process, an area of a Machine Room can be designated as a "Work Area." Barriers will be used to notify personnel of the defined "Work Area." Any additional rules and restrictions for entry and work will be posted as necessary. The following general guidelines apply to any area designated and marked as a "Work Area:"

- •**Any** entry into the marked area requires prior approval of appropriate MCS staff.
- •Guest access to the marked area is **not** allowed.
- •All individuals **must** wear work shoes.
- •All individuals **must** wear any PPE required and posted at entry points (this can include safety glasses, safety shoes, gloves, etc).
- •All individuals accessing the marked area **must** have an appropriate Job Hazard Questionnaire (JHQ) reflecting their ability to enter such an area.

I.d Special Circumstances

When considered necessary by staff, a Machine Room can be designated a "Work Area." Markings at all entry doors will notify staff of this condition. During such instances, the following rules will apply:

- •**Any** entry into the Machine Room in question requires prior approval of appropriate MCS staff.
- •General access for guests will be suspended until the condition is cleared.
- •All individuals **must** wear work shoes.
- •All individuals **must** wear any PPE required and posted on entry doors (this can include safety glasses, safety shoes, gloves, etc).

•All individuals accessing the Machine Room **must** have an appropriate Job Hazard Questionnaire (JHQ) reflecting their ability to enter such an area (i.e., not designated an "office worker").

I.e Document Review

This document shall be reviewed annually and will be updated as events and activities require. Input on procedures and practices should be reported to Line Managers for consideration and addition to this document.

II Roles and Responsibilities

II.a Work Planning and Control - Line Managers

1. Review the scope of work.
2. Identify work activities.
3. Analyze work to be performed for hazards.
4. Discuss with the ESH Coordinator, Building Manager, or Subject Matter Expert (SME) as needed
5. Define the precautions that will be followed in performing the work.
6. Review the hazards with employees before work is started.
7. Mitigate or eliminate hazards.
8. Invoke a work stoppage if continuing is determined to be be unsafe.

II.b Work Planning and Control - Employees

1. Assist supervisors in completing a hazard analysis.
2. Review the "Procedures and Guidelines for Working Safely in MCS Machine Rooms" document.
3. If the work to be completed exceeds the scope of this document, an ANL-629 - General Job Safety Analysis must be completed and submitted for approval.
4. Conduct work using hazard controls.
5. Notify supervisors when changes occur while performing the work.
6. Provide feedback to supervisors.
7. Stop work if continuing is determined to be unsafe.

II.c Rules for Subcontractors Working in the MCS Machine Rooms

1. Subcontractors are required to read the appropriate ANL-209 - Job Safety Analysis (JSA) and sign, before they start work.
2. All work is to be done under the supervision of appropriate MCS staff and only within the scope of the ANL-209(L|M|H) Job Safety Analysis (Low, Medium, or, High Risk) .
3. Subcontractors must take the Annual Contractor Safety Orientation (ESH 382) or be escorted at all times.
4. Subcontractors must have taken the Building 221 Safety Orientation.
5. Subcontractors are to stop work if continuing is determined to be unsafe.

III Emergency Procedures

III.a Fire Alarm

In the event of **smoke or fire** pull a fire alarm pull station out-side of the Machine Room to activate the fire alarm system. This will notify the Argonne Fire Department (AFD) and activate the fire bells and strobes. Pulling a pull station inside the BMR will activate only the Halon system but not the building fire system; one must call **9-1-1** or pull a station outside of the BMR. In the event of an alarm, all personnel should be evacuated from the area and an evacuation route established. Then, if trained to use a fire extinguisher, an individual may attempt to extinguish the fire. In the case of a fire alarm, proceed to the nearest exit and leave the building immediately. The assembly area for evacuation is at the front of the cafeteria, Building 213.

III.b BMR Halon System

The BMR is equipped with an underfloor Halon system. The Halon system can be triggered by two methods: automatic or manual.

III.b.i Automatic Activation

Automatic activation requires two smoke detectors of different zones to be in alarm; this is called cross zoning. Cross zoning prevents inadvertent release of the agent. If two smoke detectors of different zones do go into alarm; a horn will sound for 30 seconds before the Halon is released. When someone hears this horn he should **immediately** leave the BMR. If one is absolutely sure there is no fire, within these 30 seconds it is possible to

prevent the discharge by pulling one of the abort switches located by the BMR exit doors. Specific locations are indicated with an "A" on the Halon System Drawing (see Appendix A - Figure 1).

III.b.ii Manual Activation

Manual activation occurs by pulling one of the Halon manual release pull stations located by the exit doors. Specific locations are indicated with a "D" on the Halon System Drawing (See Appendix A - Figure 2). Pulling a manual pull station will sound the horn and immediately discharge the Halon agent. The abort switches will not prevent a manual release. This process does not initiate an alarm of the main Fire Alarm Control Panel (FACP). One **must** call 9-1-1 and pull a building fire alarm pull station to activate the fire bells and strobes throughout the building.

III.c Tornado

When a tornado warning is announced, all occupants should leave the Machine Room and proceed to either the northwest stairwell by the freight elevator or the east stairwell by the lobby in the front of the building, then follow the "Tornado Shelter" signs down to the service floor to the designated assembly area by A-007 (Vending Area). Everyone must wait in this area until an all-clear signal has been announced.

III.d Injury or Illness

Call **9-1-1**.

IV Personal Protective Equipment (PPE)

IV.a Introduction

A great deal of work is done inside the Machine Rooms. The varying tasks bring with them a number of different hazards that need to be mitigated. Some require only proper planning to complete. Other tasks require a number of protective items. The determination of what PPE is required to complete a specific task is determined during the ISM process (stage 3 "Develop/implement controls). The following is a list of the most common PPE items that may need to be used. If unclear as to what PPE is required to complete a task, one should consult written procedures, supervisor, building SME, or ESH coordinator. No work should be done until the hazards have been identified and controlled (where possible).

IV.b Hearing Protection

An acoustic survey of the Machine Rooms was completed and determined that it is safe to work in the environment in excess of 8 hours without a threat of hearing damage. However, if the tasks to be performed require the use of tools, work on electrical systems, or any other tasks that require hearing protection, such protection must be used by all those in the affected areas. In addition, each individual may be permitted to use hearing protection for his own comfort.

IV.c Safety Glasses

Certain tasks involve a chance of flying debris either from items inside racks or from openings in the pressurized floor. Air movement under the raised floor causes dust and other particles to become airborne. These particles can be pushed out of openings in the floor. Safety glasses are **required** for the following tasks:

•Removing floor tiles
•Any other tasks that already require their use

Safety glasses are recommended when working on a task that may create airborne particles or where there is a risk of eye injury.

IV.d Work Gloves

Many areas of each Machine Room introduce pinch/crush points and sharp edges that can cause cuts. Gloves designed to protect against impact and penetration are **required** for the following tasks:

- •Removing floor tiles
- •Racking and unracking computers and other equipment
- •Boxing and unboxing equipment
- •Moving equipment, boxes, and other items using lifts, carts, and other assistive devices
- •Using tools with sharp edges or points

Gloves are recommended for any instance where hands are at risk for injury due to cuts, crushing or other injury.

IV.e Work Shoes

Appropriate work shoes include enclosed toes and secure attachment to the foot. Open toes and backs should not be worn when doing work in a Machine Room. If one is moving through a Machine Room without such shoes, care should be taken. In addition, steel toe shoes (i.e. safety shoes) are required for certain tasks. They should be

ANSI Z41-PT99 rated for impact of 50 foot-pounds or more. Tasks for which safety shoes are **required** are as follows:

- •Racking and unracking computers and other equipment
- •Moving equipment, boxes, and other items using lifts, carts, and other assistive devices

All other tasks in Machine Rooms **require** work shoes, but safety shoes are recommended.

V Assistive Devices

V.a Rolling Stepstools

There are several rolling-type stepstools in the Machine Rooms. Guidelines for their use are as follows:

- •If the stool does not allow one to reach the desired height, find a higher stepstool or ladder, to avoid over-reaching or compromising one's balance.
- •Never lean forward when using the top step.
- •Place the stepstool as close to the target as possible.
- •Use stepstools one person at a time.

➡**Note that the stepstools are Not made of nonconductive materials, and hence afford no protection when working with electrical hazards. These should never be used to complete electrical tasks.**

V.b Ladders

There are several ladders inside the Machine Rooms. Each is designed for a particular type of use. The guidelines for ladder use can be found in the ESH Manual Section 7.14.6. To use a ladder in any Machine Room one must have completed Ladder Safety Training (ESH117).

V.c Equipment Lifts and Carts

There are several kinds of lifts in the Machine Rooms used for various tasks. The two commonly used ones are the pallet-jack, used for moving pallets of equipment in the Machine Rooms, and the other is the rack lift, used to lift and lower equipment for installation or removal. The following guidelines must be followed when using all equipment lifts:

- •Appropriate PPE must be used that is consistent with the task being performed.
- •Loads must be balanced on the lift or cart.
- •Loads must be secured (using mechanical means) and carried as low to the floor as possible while in motion.
- •Carts and lifts should never be secured by a person while in transit, nor should they be "ridden" at any time.
- •Operation of carts and lifts must meet the manufacturers instructions.

VI Special Considerations

VI.a Electrical

Electrical work in the Machine Rooms are to be completed by a qualified person only. There are currently three types of electrical installations each with its own set of hazards. The basic set of guidelines are as follows:

- •All new wiring must be installed according to the ANL ESH Manual Chapter 9. (Electrical Safety Program), NFPA 70 and the National Electrical Code (NEC).
- •Equipment connected to AC below the floor, unless hard-wired, should be connected by using twist lock plugs, where possible using existing power infrastructure.
- •All new underfloor outlets **must** be twist lock (NEMA L designated or IEC pin-and sleeve receptacles).
- •Power distribution wiring must be installed by a qualified electrician.
- •Cable no longer used should be removed from below the raised floor if possible.
- •LOTO procedures specific to the Machine Rooms must be followed. These procedures will be reviewed annually.

Follow ANL ESH Manual Chapter 7 – Section 7.1 (Control of Hazardous Energy and Lockout/Tag-out) for LOTO – procedures.

VI.a.i Commercial Power

Commercial power service enters the Machine Rooms through various power panels around the room. These panels are **not** to be opened by anyone other than a qualified person who has taken the appropriate training. These panels are maintained by FMS personnel as well as outside contractors retained by MCS to perform specific work. All work done by contractors must meet the guidelines in Section II.c.

VI.a.ii UPS Power

Building UPS (uninterruptible power supply), which comes into the BMR via Power Panel UPS16, supplies a small portion of systems and equipment in the BMR. This is backed by the UPS on the service floor in 221 and the building generator that supplies emergency power to the building. Power loss to the building does not mean that all circuits in the BMR are de-energized.

VI.a.iii DC Power

In the southeast corner of the BMR is the DC power installation. It consists of a set of rectifiers, breaker/fuse panels, batteries, cable infrastructure, and a grounding system. This power source is managed exclusively by MCS staff. There are cautions associated with each of the components. All individuals should be aware of the electrical hazards before starting work and **must** consult qualified MCS staff for work approval. See Appendix B for specifics on the layout as well as images of the items called out in this section.

VI.a.iii.1 Rectifiers

The rectifiers take AC power and transform it into DC power. These devices take multiple high-voltage circuits as input. In addition, there are multiple low-voltage (-54 vdc) outputs that carry a great deal of amperage (100-200 amp). The controls located on the front of these devices should not be adjusted except by a qualified person. Care should be taken when working in Network Row (M32-48) to avoid contact with controls, inputs, and outputs. Freight must not be taken up this aisle to avoid contacting these devices. Care should also be taken when working under the floor or on ladders, because of an increased risk of contacting inputs or outputs.

VI.a.iii.2 Breaker Panel

A single breaker panel controls DC power distribution throughout the BMR. This device has multiple inputs and outputs. It carries well over 400 amps of potential power. The rear of the panel is enclosed in plexiglass for protection. The top and bottom are open. Because the front of the panel is not enclosed, care should be taken not to contact any breakers. This would interrupt power to devices which utilize DC power. Care should also be taken when working near the rear of the breaker panel as there is an increased risk of contacting inputs or outputs. Freight must not be taken up this aisle in order to avoid contacting these devices.

VI.a.iii.3 Fuse Panels

The fuse panel provides low-amperage distribution (1-20 amp) to devices in Network Row (M32-48). It carries 200 amp of potential power. The rear of the panel is protected from incidental contact but is not fully enclosed. Care should also be taken when working on ladders near the rear of the fuse panel as there is an increased risk of contacting inputs or outputs.

VI.a.iii.4 Battery Array

The array contains 24x440 amp-hour sealed batteries. There is a huge amount of potential energy stored in this array and creates a serious hazard if care is not taken. Opening of floor tiles within 4’ or use of a ladder within 8’ **requires** prior approval and supervision of a qualified MCS staff member. Care should also be taken when working near the array as there is an increased risk of contacting terminals. Freight must not be taken up this aisle in order to avoid contacting battery terminals. Storage within 36” of the array is **not** allowed.

VI.a.iii.5 Cables and Connections

There are multiple connections to devices using DC power. They use THHN wire of varying gauges (depending on the amperage rating of the circuit). Connections in Network Row (M32-48) are not protected by anything other than the insulation on the wire. Care should be taken when working near such cables as use of sharp tools could compromise insulation and create an electrical hazard. In addition, no other cable should be secured on, to, or near this cable. Cable that goes under the floor is protected by flexible conduit and appropriate fittings. Pulling on, moving, or making other adjustments of DC-carrying conductors **requires** prior approval and supervision of a qualified MCS staff member.

In addition, care should be taken when working near DC power connections. There is an increased risk of electrical contact when near terminals that are protected but not fully enclosed.

VI.a.iii.6 Grounding System

All DC-powered devices in the BMR are connected to the grounding system. Interruption of this system creates an electrical hazard for anyone working in the BMR. The DC-connected systems in Network Row (M32-48) are either directly grounded to the ground bar in the DC breaker panel or grounded directly to the racks in which they are secured. The large grey racks are all attached to the grounding system. The entire system is connected to Earth ground via a 4/0 green-sheathed cable running under the floor between Network Row (M32-48) and Hackspace (C-120). It attaches to a copper grounding plate below power panel RP4. Grounding wires can be identified as follows:

- Uninsulated (bare) copper wire
- Solid green insulated copper/aluminum wire
- Green with a yellow stripe insulated copper wire

•Any (non white) copper conductor identified with green tape or paint at the terminal end

One should never pull on, cut, or disturb grounding wires. Any such activity **requires** prior approval and supervision of a qualified MCS staff member.

VI.a.iii.7 Circuit Breaker Panels

The following tasks shall only be performed by a qualified person:

- •Opening of panel door or cover
- •Turning on or off breakers
- •Resetting tripped breakers
- •Altering panel documentation

During such operations, the qualified personnel shall have appropriate training, PPE and knowledge of the electrical system supported by the panel in question. Any such activity **requires** prior approval and supervision of a qualified MCS staff member.

VI.b Lockout Tagout (LOTO)

The electrical systems in the Machine Rooms, as described above, should be locked and tagged only by qualified and appropriate staff members. A Lockout Tagout (LOTO) station is located in the southwest corner of the BMR, near the phone. It is complete with locks, locking devices, tags, and a log book consistent with the Argonne LOTO policy in ESH Manual Chapter 7 – Section 7.1 (Control of Hazardous Energy and Lockout/Tagout). This covers standard applications of LOTO. However, the DC plant requires a complex procedure that is included in Appendix B. This procedure is to be carried out only by a qualified person.

VI.c Barricades

When actively doing work, barricades must be used to alert individuals in the BMR of any hazards introduced as a result of the work being done. Barricades should be stationed to provide enough room for work to be comfortably completed. The following guidelines should be used to determine the work area:

- •A minimum of 48” is required as a buffer between the work being done and the edge of the work area.
- •Space for tools, equipment and other necessary assistive devices should be provided **within** the work area.
- •When working between rows of racks, the ends of the row should be barricaded.
- •When working in open spaces in the MCS Machine Rooms, barricades should fully surround the work area to at least the minimum distance required above.
- •When lifting floor tiles, the barricades must be placed at least two tiles away from the opening in the floor.
- •Barricades must be returned to their designates storage space when work is complete.

VII Working under the Floor

VII.a Introduction

In the Machine Rooms, much of the infrastructure used to connect systems resides under the floor. Access to this infrastructure generally means opening up floor tiles. This introduces additional hazards both for the individual(s) doing the work, and for others in the Machine Room. The following guidelines should be followed to mitigate the hazards.

VII.b Removing and Replacing Floor Tiles

When opening up floor tiles the following rules **must** be followed:

- •Lifting floor tile V39, V40, W39, or W40 requires prior approval of appropriate MCS Staff (the Halon Catch Basin resides under these tiles).
- •One should Minimize the number of floor tiles open at one time for any task.
- •Floor tiles must be removed only with the approved “floor tile lifter” located along the walls of the Machine Rooms at designated “stations.”
- •Appropriate barriers and warnings should be put in place to warn other staff of the hazard.
- •Open tile areas that are unattended for any length of time **must** be barricaded (See section VI.c for details).
- •Tiles should fit back in place. Kicking, stomping, or jumping on tiles is **not** permitted.
- •Tiles should not be left open overnight.
- •Removing tiles with vents should be done carefully as the vent extends deeper under the floor than the tile itself and has the potential to catch on cables and other things under the floor. In addition, the edges of the vents are sharp and may cut or otherwise damage underfloor infrastructure.

The procedure for removing and replacing tiles is as follows:

1. Don appropriate PPE for the the task.
2. Mark the area as appropriate for the task to be completed.
3. Place the panel lifter in the center of the tile and press down firmly.

4. Lift one tile edge enough to clear surrounding tiles, and slide it out of the way (keeping fingers, clothing, cables, etc clear of the tile).
5. Complete work as quickly as possible.
6. Place the panel lifter in the center of the tile and press down firmly.
7. Slide the tile edge back toward the open space (keeping fingers, clothing, cables, etc. clear of the tile).
8. Check that the replaced tile is level with adjoining tiles; (if not, repeat steps 2-3 and then replace the tile again).
9. Place the panel lifter back in its appropriate station.

VII.c Running Cables

When running cables under the floor, certain rules apply to maintain a neat and consistent underfloor environment. The following guidelines are to be followed:

- •Follow rules regarding opening floor tiles (Section VII.b).
- •Use underfloor trays for cables where available.
- •Avoid wrapping cables around floor supports, fixed structures, or existing cable installs underfloor.
- •Do not secure cables to any fixed structure underfloor, such as electrical conduits, trays, and water lines.
- •Place cables under electrical whips to avoid interrupting electrical connections or contacting conductors
- •For installation in underfloor spaces, use cable rated for such activities.
- •Protect egress points where cables exit the underfloor space, by using appropriate collars/fittings to ensure that cables are not damaged by sharp edges.
- •Ensure that cables have enough slack to provide for appropriate bends and to ensure no tight corners.

VII.d Removing Cables

When cables are no longer needed, they should be removed to ensure no clutter under the floor. The following rules apply to this process:

- •Rules regarding opening floor tiles (Section VII.b) must be followed.
- •One should never tug on or pull cables from one end. They will likely become tangled and pull on other cables and underfloor infrastructure and can result in damage to equipment or harm to the individual.
- •If a cable is to be abandoned, slack should not be stuffed under the floor (this creates new problems). With approval, the ends of the cable (including slack) should be cut off and the end appropriately sealed.

VII.e Making Electrical Connections

Extra care should be taken when making electrical connections under the floor. The cable must be protected from damage where it passes up from under the floor (see section VII.c). In addition, the connection to the receptacle must be secure (see section VI.a). If a locking receptacle is not available, every effort must be made to provide enough slack such that the plug does not pull away from the receptacle, exposing the conductors. Because most equipment in the Machine Rooms use NEMA 5-15 or 5-20 plugs (straight-blade), it is recommended that these connections be made in racks to UL-approved distribution panels with L5-20 or greater plugs. Any plugs NEMA 6-15 or 6-20 **must** be fitted with appropriate twist-lock L6-xx plugs.

VIII Racking, Unracking, and Maintaining of equipment

VIII.a Introduction

A common and potentially hazardous task in the Machine Rooms is the addition or removal of equipment from free-standing racks. It is important to start with appropriate PPE before work begins (Section IV), as well as to have the correct number of individuals assisting. If assistive devices such as carts and lifts will be used, one should consult Section V.c for guidelines on safe use of these devices.

VIII.b Racking of Equipment

The following list of guidelines should be followed when placing systems in racks:

- •Appropriate number of individuals and PPE **must** be used to accomplish tasks.
- •Equipment **requires** approval from appropriate staff prior to racking.
- •New equipment should be loaded from the bottom of the rack (adding equipment at the top of a rack can cause tipping).
- •Be sure to secure rail systems to the racks as specified by the manufacturer.
- •Be careful of pinch/crush points as rails and equipment are added (edges and mount-points can be sharp).
- •It is **recommended** that equipment be secured individually to racks and not placed directly on top of other equipment.

Use of shelves in racks:

- •The use of shelves is **permitted** only in cases where racking systems is not possible.
- •The shelf **must** be designed to be integrated in the rack.
- •The shelf **must** be securely attached to the rack.
- •The load limit for the shelf **must** not be exceeded.
- •It is **recommended** that equipment be secured to the shelf (the equipment should be prevented from being unintentionally pushed out of the rack).

VIII.c Unracking of Equipment

The following list of guidelines should be followed when removing systems in racks:

- •Use the appropriate numbers of individuals and PPE to accomplish tasks.
- •Remove equipment from the top of the rack (topmost system to be removed should go first).
- •Disconnect any cables or connectors from the system before sliding out of the rack.
- •Be careful of pinch/crush points as rails and equipment are removed (edges and mount-points can be sharp).

In addition, removal of cables, racking kits, and other infrastructure is **recommended** to avoid clutter and tripping hazards.

VIII.d Maintenance of Equipment

Routine maintenance of equipment in racks that requires sliding out on rails should be done under the following guidelines:

- •Ensure enough slack in cables to allow for free sliding on the rails.
- •Ensure enough counterweight in the rack to prevent tipping.
- •Install tip kits on racks where counterweight is not sufficient to prevent tipping.
- •Do not use a person's weight or assistance to prevent racks from tipping.
- •Be careful of pinch-points as rails and equipment is moved on rails.
- •Never lean on or support oneself on a piece of equipment extended out of the rack on its rails.
- •If a ladder or stepstool is necessary to access the internals of equipment when extended on its rails, unrack the equipment for the maintenance activity where possible.

IX Lasers

IX.a Introduction

There is a small amount of laser equipment located in the Machine Rooms. Its operation and maintenance should be undertaken by qualified personnel for non-Class 1 laser systems. One should, if unsure, consult appropriate staff for clarification of classification. Section 6.2 of the ESH Manual covers specific details on laser safety and should be consulted for the planning of work in the Machine Rooms for non-Class 1 laser systems.

IX.b Class 1 Lasers

Most of the fiber-based network connections throughout the Machine Rooms are classified by the manufacturer as Class 1 laser products (based on the ANSI Z-136.1 standard). They contain interlock systems that do not activate the laser when the connection is unmated providing, a Class 1 LASER enclosure. It is good practice to avoid looking into unmated network adapters regardless. It is also good practice to place appropriate covers into such connectors, both to protect individuals working in the area and to protect the optics from dust, dirt, and other debris. Damaged fiber optic cable (orange and yellow jacketed cables throughout the Machine Rooms) should be reported to appropriate staff, as laser radiation can escape if the jacketing and insulation are removed posing additional hazards.

IX.c Class II Lasers

There are no known Class II laser sources in the Machine Rooms.

IX.d Class IIIa/b Lasers

BMR Rack M46 in Network Row contains telecommunications carrier equipment from several vendors. They contain optics that operate with wavelengths at or above 1300 nm (invisible to the human eye). While the faceplates are in place, leakage of laser radiation is not possible so they qualify as a Class 1 laser enclosure. Only qualified personnel are authorized to remove covers or work on this equipment. Covers should be secured in place unless work is currently being done on this equipment. When covers are open, caution should be taken not to look into any open receptacles or couplers as they may emit laser radiation that could be harmful. In addition, any receptacles that will not be used should be covered with appropriate plugs when possible to protect individuals as well as the optics. Care should be taken when working on this equipment to avoid eye contact with active sources. Just because one cannot see the light, doesn't mean the laser is not active.

IX.e Class IV Lasers

There are no known Class IV laser sources in the Machine Rooms.

Appendix A (Diagrams and Figures)

Figure 1 (Halon System Drawing)

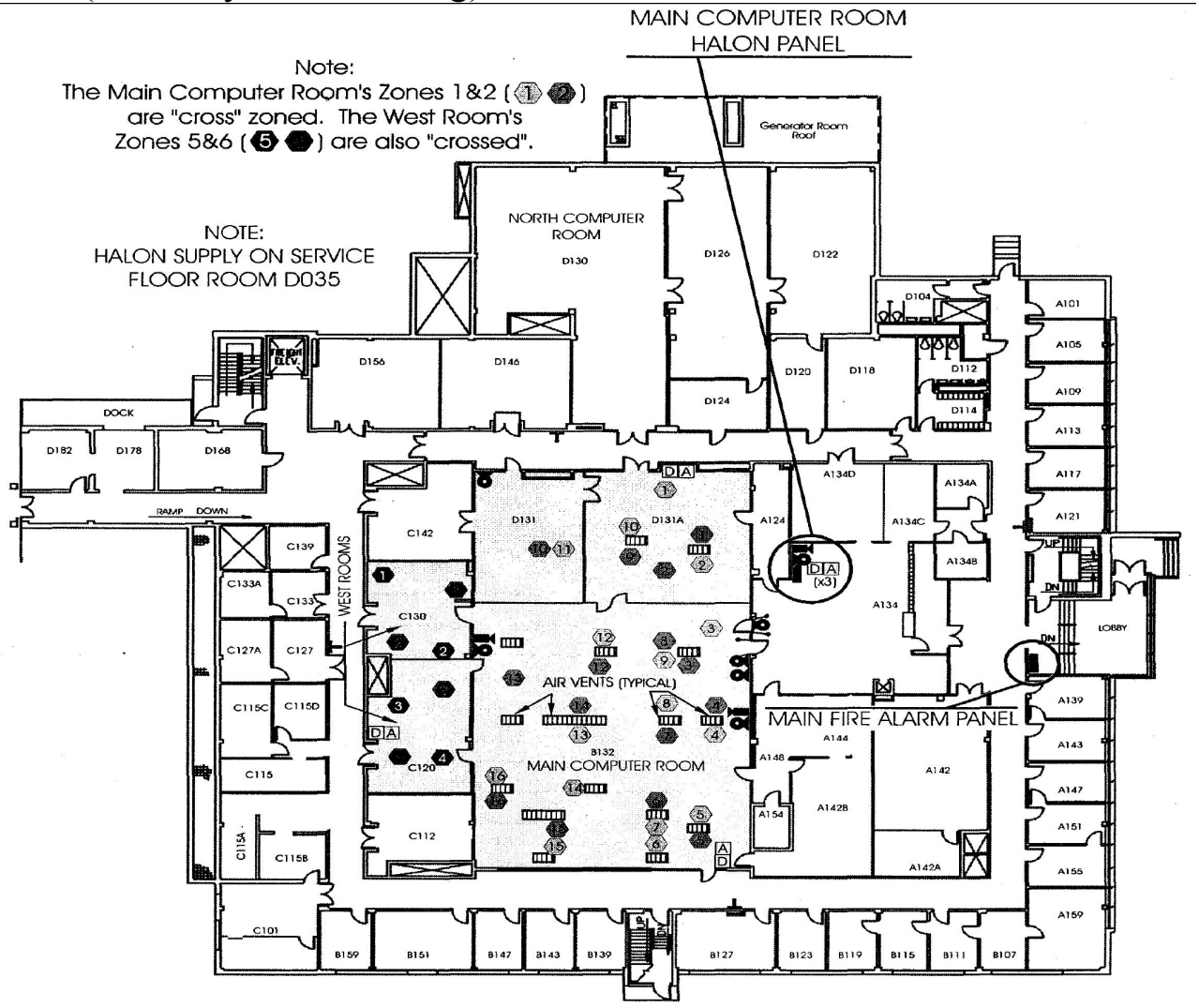
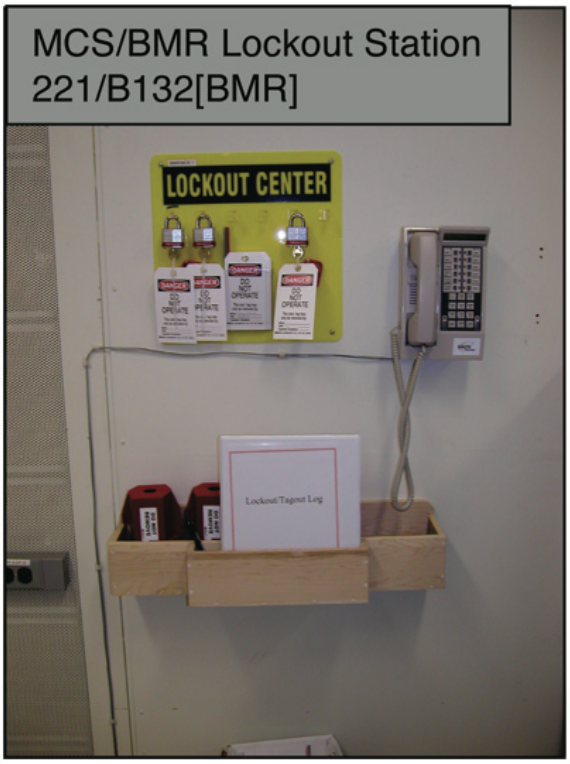


Figure 2 (Halon System Manual Pull Switch)

Appendix B (LOTO Procedure for DC Power Plant)

Introduction

The DC Power Plant (DCPP) located in the BMR provides -54 vdc power to gear in network row (M32-48). Two individual power sources that feed the DCPP including two AC sources and one battery array. All of these sources must be identified and locked out prior to work being done. This document provides the procedure to place both of the DC busses in an electrically safe work state.



LOTO Station

The logbook in the BMR LOTO station contains copies of the ANL-469 (3-06) form, which is used to record activities of the station. The binder holds the archives of the work that has been done. It must not be removed from the lockout station.
Other elements of the station include 4 plug lockout devices, 4 locks, 4 hasps, and a set of tags to be used in the LOTO procedure noted below.

Electrical Work

Electrical work must be done by trained and qualified personnel that have completed the following:
•Basic electrical safety
•LOTO training
•NFPA 70E training
•Walkthrough of the procedure listed below
Work must be done using the following equipment:
•Protective eye-wear (user supplied)
•Flash jump-suit located in the BMR
•Face shield, gloves, hearing protection, and other PPE in the BMR
During work, barricades must be used to keep other individuals not involved in work at the appropriately determined safe distance (See section VI.c for details)

All work must be done in the presence of a spotter who has the appropriate training listed above and is familiar with the system.

Electrical Layout

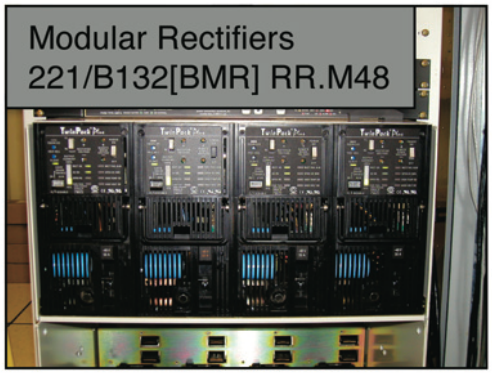
The DCPP can be divided into two busses A and B. Bus A is fed in two ways. Its AC source is provided by 4 220 vac @ 30a circuits fed from panel RP4 located in the hackspace (directly adjacent to the BMR 221/C120). Each of the four circuits is terminated under the raised floor with a single L630R outlet. They are located as follows:

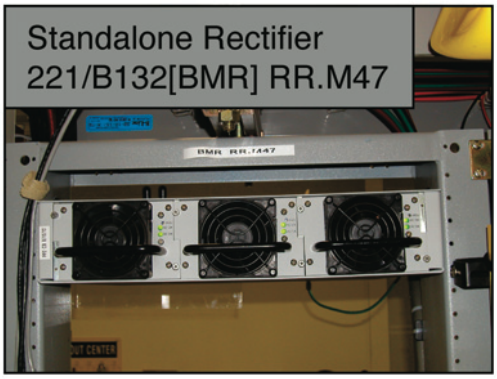
Slot 1, Module 1 - RP4-C26/28 under L46
Slot 1, Module 2 - RP4-C30/32 under L46
Slot 1, Module 3 - RP4-C22/24 under L45
Slot 1, Module 4 - RP4-C6/8 under L45

Located above the floor J50-K51 is a 24 battery array that acts as backup power for the A bus. This comprises 24 2.2 vdc Absolyte 440 amp-hour batteries (closed cell). This provides for 3+ hours of -48 vdc power @ 75% load. When AC on bus A is interrupted, the battery array will continue to power the bus until the nominal voltage drops from -54.3 to -47.8. At this point the low-voltage shunt will be opened. Both of these sources must be isolated for safe work to be complete. There is a 700a breaker located on the center panel of the DCPP in RR.M48 labeled Battery Cutoff.

Bus B is fed from a standalone rectifier located in RR.M47. This is fed by a 3-phase WYE circuit in PP2-C8/10/12 (BMR East wall). The outlet is found under N46 and can be decoupled. This is the only source for this bus, and isolating this rectifier will de-energize the complete bus.

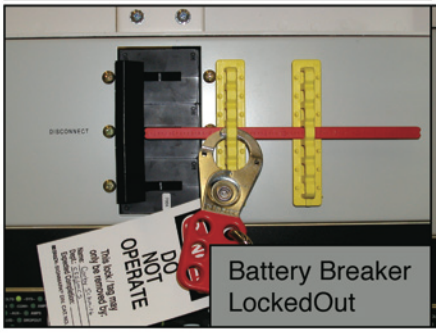
Above I48 on the wall is the MCS/BMR LOTO Station. This station has standard lockout devices for the circuits fed from RP4 and PP2. It also has special lockout devices for isolating the plugs that feed the rectifiers in RR.M48 and RR.M47.

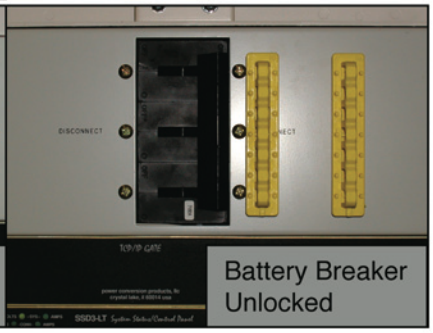




Lockout Procedure for Bus A

•Create an entry in the logbook on the BMR LOTO station.
•Shut down AC source.
    •The following circuits must be locked out in panel RP4: 6/8,22/24,26/28,30/32.
    •Alternatively the L630P plugs can be decoupled under the floor and placed in lock boxes located in the LOTO station.
        •Place plug in the Lock-box or add breaker lockout device on the panel. Apply the hasp
•Fill out the tag.
•Apply the lock and tag to the hasp.
•Shut down DC battery backup.
    •Open the battery breaker.
    •Using the lockout bar (red), slide it in place so the breaker cannot be closed.
•Fill out the tag.
•Apply the lock and tag to the hasp.

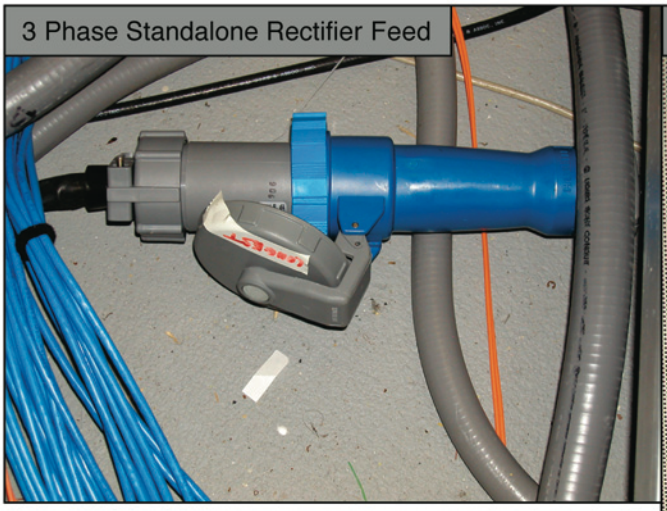


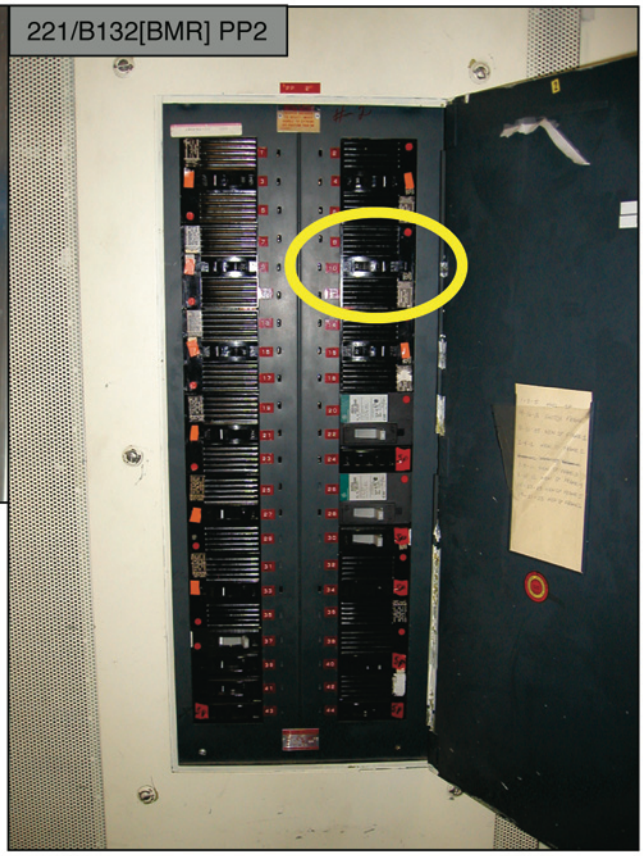


Lockout Procedure for Bus B

Create an entry in the logbook on the BMR LOTO station.
Shut down AC source.
The following circuits must be locked out in panel PP2: 8/10/12. Using the standard breaker locks in the LOTO station one can be accomplish this task as follows:

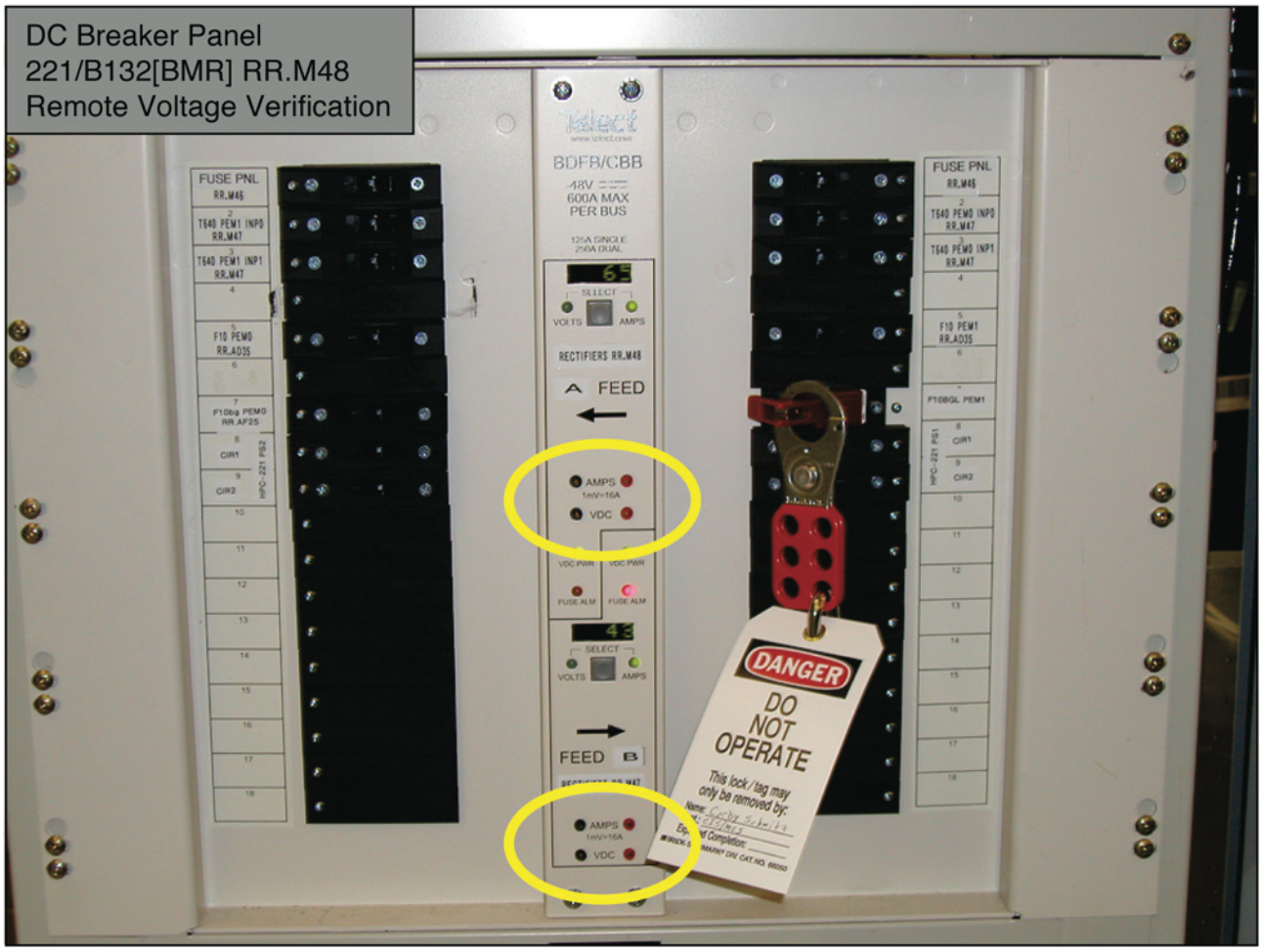
- •Place plug in the lock-box, add the breaker lockout device on the panel, and apply the hasp.
- •Fill out the tag.
- •Apply the lock and tag to the hasp.





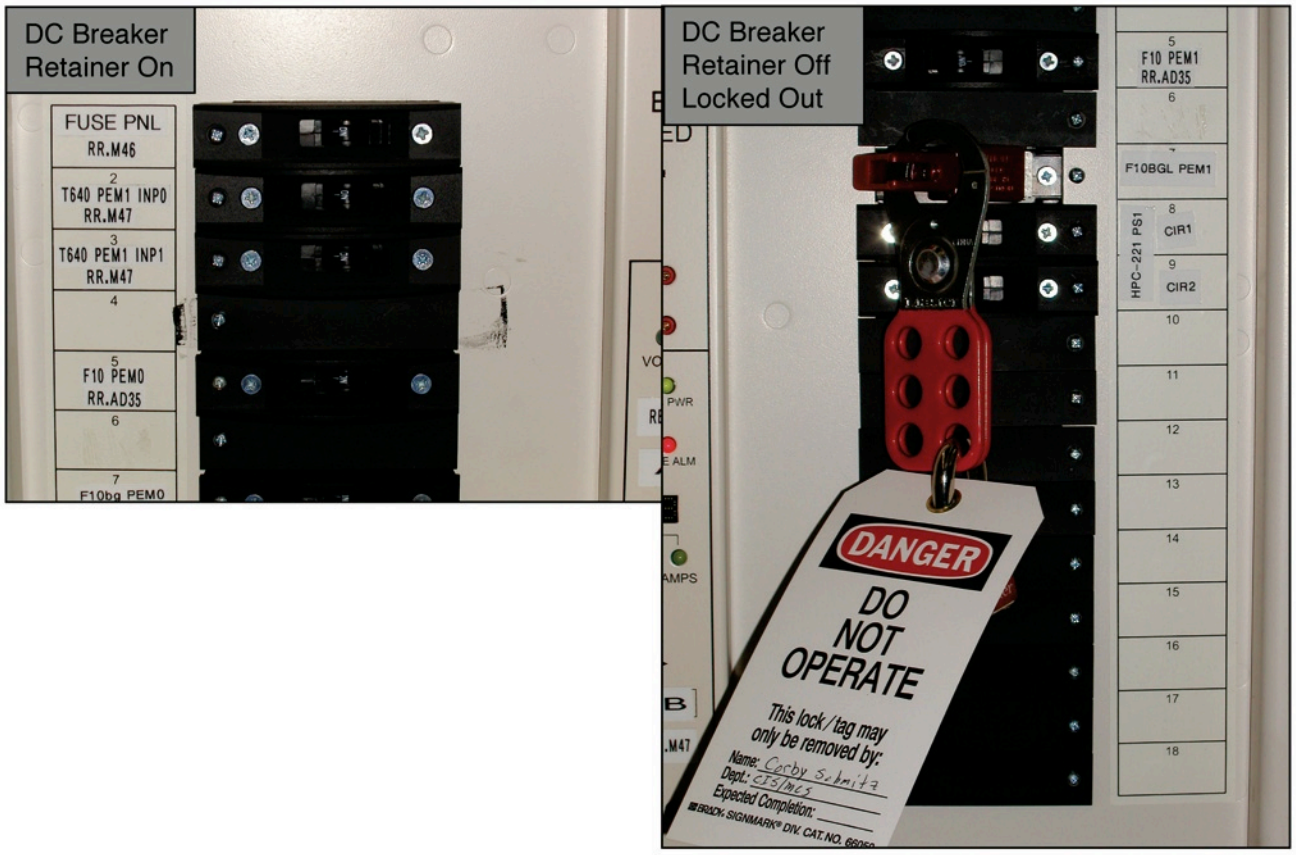
Verification Procedure

The front breaker panel (RR.M48) provides voltage testing ports to ensure no voltage prior to removing the plexiglas panel exposing the bus panels on the rear. Once this initial test is complete, the rear panel can be removed, and both the A and B bus can be tested.



Lockout Procedure for DC breakers

Create an entry in the logbook of the BMR LOTO station.
Remove the 3 head screws that attach the breaker retainer.
Remove the retainer.
Replace the 3 head screws to the breaker panel and breaker.
Apply standard no-hole breaker lockout device, and attach the hasp.
Fill out the tag, and attach the lock.



Removing LOTO

Once work is complete, do the following:

- Remove the lock, tag and hasp.
- Power the system back up.
- Complete entries in the logbook in the BMR LOTO Station.
- Clear the tag.
- Return all LOTO components to the LOTO station.

Appendix C (Acceptance Agreement)

Acceptance of the Procedures and Guidelines for Working Safely in MCS Machine Rooms (v1.9 - 1/13/2009)

I have read and understand the “Procedures and Guidelines for Working Safely in MCS Machine Rooms.” I have worked with appropriate staff to adjust my JHQ (Job Hazard Questionnaire) to reflect the work I will be doing in these Machine Rooms. In addition, I have been enrolled in or have completed all training pertinent to the work I will be doing in the Machine Rooms. I agree to follow these procedures and receive approval from appropriate staff to complete my tasks in a safe manner.

Name and Badge:_____
Signature:_____
Today’s Date:_____